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CALCULATION OF ROYALTIES BASED ON NETBACK METHOD

CALCULATION OF ROYALTY WAIVER BASED ON EXPANDED NETBACK METHOD

APRIL 1991

for

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER RESOURCE MANAGEMENT

by

Steven E. Morris
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Calculation of Royalties Based on Netback Method
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April 1991

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Introduction

To encourage the development of geothermal energy in Hawaii, the Board of Land and Natural Resources (the "Board") has the authority to waive royalty payments that would otherwise be due to the State of Hawaii (the "State") from the production of geothermal resources from State leases. The Board's assessment of each application for royalty waiver is required by statute to include the examination of such factors as the need for providing financial incentives in order for the applicant to proceed with development. The Board can waive royalties for a maximum period of eight years.

The decision on whether or not to grant royalty waivers to a project is a difficult process that involves many considerations. I believe it would be useful for the Board to separate its decision on whether or not to grant royalties waivers to a project from its decision as to how much and when the royalties should be waived.

Further, I believe that the timing and amount of royalties to be waived should be determined on the basis of the actual results of operations and not based on projections. Determining the timing and amount of royalties to be waived based on the actual results of operations gives the Board the opportunity to provide support to projects based on actual need, not projected need. If a project operates better than expected, the Board won't be in the position of being committed to waive a fixed amount or fixed percentage of royalties when financial support to the project is not needed.

Uncertainty as to the specific amount of royalties to be waived should not cause any major concern to the developer or its financial backers in that the amounts to be waived will vary only if the results of operations vary from the projections. If the results are better than projected, the developer should not mind receiving a lower subsidy from the State.

The Puna Geothermal Venture ("PGV") has requested that the Board agree to waive 60% of the royalties that would otherwise be due to the State during the first eight years of operations of its Puna geothermal project (the "PGV Project").

In connection with PGV's request, I have reviewed the projected operating cashflows of the PGV Project submitted in

support of the waiver request. My review was performed in the context of 1) using the assumptions in the projected cashflows to calculate the amount of royalties that would be due the State based on the geothermal netback method of valuing geothermal resources and 2) recommending to the State, a methodology to be used in evaluating requests for royalty waivers.

A copy of my comment letter regarding the projected cashflows of the PGV Project, which was sent under a separate cover, is Exhibit 1 to this report.

Set forth below are the royalty calculations for the first eight years of the PGV Project using the geothermal netback method of valuing the resource produced from State leases. Also below are the details of a methodology for calculating an appropriate amount of royalties to be waived for projects determined by the Board to qualify for royalty waiver consideration. The results of applying this methodology to the projected operating cashflows of the PGV Project are also contained in this report.

Netback Method of Royalty Calculation

In my February 1991 report to the State, "Review of Methods Used in the Geothermal Industry to Value Resource", I recommended that the State adopt the geothermal netback valuation method (the "Netback Method") for valuing resource produced from State leases when such resource is not subsequently sold under the terms of an arms-length steam sales contract. The Netback Method was recommended because I believe it is logical and fair. In addition, it can be consistently applied to multiple projects.

The Netback Method has been developed by the Mineral Management Services ("MMS") of the Department of the Interior to value geothermal production from Federal leases when the resource is not subsequently sold under the terms of an arms length steam sales contract. The MMS has spent considerable time and effort to develop this method in a manner that protects the interests of the resource owner without being unfair to the developer. The Netback Method is currently under administrative review and changes may be forth coming. Calculations contained in this report are based on existing regulations.

The Netback Method determines the value of the geothermal resource used in a given project by subtracting the reasonable cost of transmission and the reasonable cost of generating electricity from the proceeds of the sale of the electricity. The remainder in this calculation is considered to be the value of the geothermal resource. Reasonable cost includes a return on invested capital for each cost category.

Table I below shows the amounts of royalties that would be due to the State and the resource value as a percentage of the total project revenues for each of the first eight years of the PGV Project. These amounts have been calculated using the Netback Method and the assumptions provided by PGV. The assumptions used in the calculations are listed in Exhibit 2. Details of the Netback Method royalty calculation for each year are contained in Exhibit 3.

Also shown in Table I are the amounts of royalties that would be due the State based on the assumption used by PGV in its projected cashflows. PGV has valued the resource at an amount equal to 33% of the project revenues.

Table I Royalty Amounts - PGV Project

	Netback Method		PGV Assumption	
Year	Royalty Amount	Resource Value as a % of Project Revenue	Royalty Amount	Resource Value as a % of Project Revenue
1	$ 658,620	39.51 %	$ 550,000	33 %
2	666,950	40.01	550,000	33
3	674,794	40.48	550,000	33
4	742,226	42.97	570,000	33
5	815,620	45.47	592,000	33
6	891,850	47.85	615,000	33
7	897,488	48.15	639,000	33
8	1,053,104	52.28	665,000	33
	$6,400,652		$4,731,000	

Methodology for Calculating Royalty Waivers - The Expanded Netback Method

I believe that the logic and fairness of the Netback Method can be expanded from valuing the resource to valuing the project as a whole. This would then, provide a basis upon which to determine the amount of royalties, if any, to be waived for a project.

The Netback Method values resource by subtracting the reasonable cost of the other aspects of the project from the total project revenues. The Expanded Netback Method values the project as a whole by subtracting the reasonable cost of all aspects of the project, including steam production, from the total project revenues. This calculated project value is considered to be the amount available for royalty payments. If the amount is negative or less than the amount of royalty due, then all or a portion of the royalty is waived. Table II illustrates the concept of the Expanded Netback Method.

Table II Concept of the Expanded Netback Method

	Year of Operation		
	1	2	3
Total Project Revenues	$ 1,000	$ 1,200	$ 1,300
Less:			
Transmissions Costs	60	60	60
Generating Costs	600	600	600
Steamfield Costs	500	500	500
Total Costs	1,160	1,160	1,160
Project Value (amount available for royalties)	(60)	40	140
Calculated Royalty	34	54	64
Royalty to be Paid	0	40	64

The above table illustrates the three situations that can occur when using the Expanded Netback Method . In year 1, insufficient value exists to pay any of the royalties. Accordingly, the royalties are waived. In year 2, the project value is such that a portion of the royalties can be paid. In year 3 the project value is such that all of the royalties can be paid.

Calculations in the Expanded Netback Method are made in the same manner as the calculations in the Netback Method with the following exceptions.

1. The Expanded Netback Method would include a cost category for steamfield development and operations. The cost rate for steam is determined in the same manner as the cost

rate for transmission and electricity generation.

2. The Netback Method contains cost limitations for each category of cost to protect the resource owner from excess costs. Because the purpose of the royalty waiver is to help the project during periods of high cost, limitations are disregarded in the Expanded Netback calculations.

3. The rate of return on invested capital has been increased to 150% of the S & P Industrial Bond Rate. It is not the intent of this proposed methodology to suggest or define a hurdle rate of return below which the Board would grant royalty waivers. However, the rate of return selected does significantly affect the calculation. For example, the rate of return on invested capital used in the calculations below is 15%. When this rate is changed to 14.5%, the result is that sufficient funds are available to pay all royalties. When this rate is changed to 17.5%, the result is that there are no funds available to pay royalties.

Table III below shows the results of applying the Expanded Netback Method to the assumptions contained in the PGV Project projected cashflows. Specific assumptions used are listed in Exhibit 5. Details of the calculations for each year are contained in Exhibit 6. Royalty amounts are from Table I.

Table III Royalties Waived - PGV Project

		Expanded Netback Method		
Year	Royalty Amount	Available for Royalties	Royalties to be paid	Royalties Waived
1	$ 658,620	$ (12,815)	$ 0	$ 658,620
2	666,950	226,979	226,979	439,971
3	674,794	461,346	461,346	213,448
4	742,226	690,016	690,016	52,210
5	815,620	912,704	815,620	0
6	891,850	1,129,110	891,850	0
7	897,488	1,338,920	897,488	0
8	1,053,104	1,541,805	1,053,104	0
	$6,400,652		$5,036,403	$ 1,364,249

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March 25, 1991

Mr. Manabu Tagomori
Deputy Director
Division of Water Resource Management
P.O. Box 373
Honolulu, Hawaii 96809

Re: Review of Puna Geothermal Venture's Projected Operating Cashflows as per Item 5 of Our Letter of Agreement - Amendment No. 1.

Dear Mr. Tagomori:

I have reviewed the projected operating cashflows for the Puna Geothermal Project that were submitted to the State of Hawaii ("State") on December 11, 1990. These projected operating cashflows were submitted by the Puna Geothermal Venture ("PGV") in support of its request for a waiver of 60% of the royalties that would otherwise be due the State for geothermal resources produced from State leases.

My review was performed in the context of 1) using the assumptions in the projected cashflows prepared by PGV in calculating the amount of royalties that would be due the State based on the geothermal netback method of valuing geothermal resources and 2) recommending to the State a methodology to be used in evaluating requests for royalty waivers.

PGV has considerable knowledge, expertise and experience in the development and operation of geothermal projects. Accordingly, I have not attempted to second guess PGV's assumptions on the costs of developing and operating the project. My questions and comments have been formulated to obtain information that is relevant to evaluating PGV's request for a royalty waiver and/or is necessary for the geothermal netback calculation.

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Comments and Questions for PGV

1. PGV has indicated in the information submitted on December 11, 1990, that the ultimate term financial structure for the project has not been finalized and is largely dependent on the outcome of its royalty waiver request. Please explain what structures are being considered and what affect the royalty waiver has on the considerations.

2. In what ways will granting a royalty waiver for this project provide benefits to the State in terms of encouraging the development of geothermal resources?

3. What affect, if any, does the royalty waiver have on the financial viability of their project?

4. PGV has asked the State to waive 60% of its royalty. How was the 60% derived?

5. What is the project's estimated annual amount of gross electricity generation?

6. What is the project's estimated annual amount of tailgate electricity as measured on the high voltage side of the transformer?

7. What is the basis for using 33% of the electricity revenues as the value of the resource for royalty calculations? How does this percentage compare with other geothermal projects?

If you have any questions or comments on the above items or if you would like to discuss any other issues related to the projected cashflows prepared by PGV please give me a call.

Very truly yours,

Steven E. Morris

Puna Geothermal Venture
Calculation of Royalties Based on Geothermal Netback Method
Assumptions

how is this estimated ?

	Source of Assumption	Year One of Operation
Electricity delivered (kwh)	PGV	209,330,000
Electricity generated (kwh)	Estimated	213,516,600
Electricity tailgate (as measured on the high voltage side of the transformer) (kwh)	Estimated	211,423,300
Electricity revenues (energy and capacity)	PGV	$16,671,000
Resource delivered (pounds)	Estimated	5184000000
Lease royalty rate		10.00%
S & P BBB Industrial Bond Rate	Estimated	10.00%
Transmission-line costs		
Capital costs	PGV	$10,000,000
Salvage value	Estimated	$0
Length of electric sales contracts (years)	PGV	35
Operating and maintenance costs	PGV	$120,000
S & P BBB Industrial Bond Rate	Estimated	10.00%
Cost rate - Depreciation Method (per/kwh)	Exhibit 4	0.006584
Cost rate - Return on Investment Method(per/kwh)	Exhibit 4	0.005245
Method used for netback calculation 1-Depreciation 2-Investment		1
Generating costs		
Capital costs	PGV	$60,000,000
Salvage value	Estimated	$6,000,000
Length of electric sales contracts (years)	PGV	35
Operating and maintenance costs	PGV	$1,850,000
S & P BBB Industrial Bond Rate	Estimated	10.00%
Cost rate - Depreciation Method (per/kwh)	Exhibit 4	0.041181
Cost rate - Return on Investment Method(per/kwh)	Exhibit 4	0.036765
Method used for netback calculation 1-Depreciation 2-Investment		1

different from exhibit 4, item (F), Delivered vs. generated electricity

Puna Geothermal Venture

Calculation of Royalties Based on Geothermal Netback Method

Year 1

Delivered Electricity	209,330,000 kwh
Tailgate Electricity	211,423,300 kwh
Value of delivered electricity	$16,671,000

Transportation deduction:

Transmission line costs (cost rate x delivered electricity):

$0.006584 /kwh x 209,330,000 kwh = ~~$1,378,151~~ (1,378,229)

Transmission as percentage of delivered value:	8.27%
Allowable deduction for royalty calculation (50% of electricity value)	~~$1,378,151~~ 229
Tailgate value of electricity	$15,292,849

For the PGV project, delivered elect. is same as tailgate elect.

Normally, tailgate is distinguished from delivered due to "line loss" attributed to the transmission of elect. from the high voltage side of the transformer to the utilities' substation or point of purchase.

Generating deduction

Generating costs (cost rate x tailgate electricity):

$0.041181 /kwh x 211,423,300 kwh = $8,706,653

Generating costs as a percentage of tailgate value:	56.93%
Allowable deduction (2/3 of tailgate value)	$8,706,653
Value of geothermal production	$6,586,196
% of total revenue	39.51%
Royalty amount (value of geothermal production x royalty rate)	$658,620
% of total revenue	3.95%

parasitic use

(can be the same, also)

Gross elect. output (219,000,000) DLNR → tailgate elect. → delivered elect. (209,330,000)

(25,000 Kwh x 24hrs x 365 days)

or

(232,183,800) PGV

(28.5MW x 8760 x 93% efficiency)

line loss from transformer to point of purchase

Puna Geothermal Venture

Calculation of Royalties Based on Geothermal Netback Method

Year 2

Delivered Electricity..... 209,330,000 kwh

Tailgate Electricity.. ..... 211,423,300 kwh

Value of delivered electricity.....$16,671,000

Transportation deduction:

Transmission line costs (cost rate x delivered electricity):

$0.006478 /kwh x 209,330,000 kwh = $1,356,022

Transmission as percentage of delivered value: 8.13%

Allowable deduction for royalty calculation
(50% of electricity value)..... $1,356,022

Tailgate value of electricity.....$15,314,978

Generating deduction

Generating costs (cost rate x tailgate electricity):

$0.040892 /kwh x 211,423,300 kwh = $8,645,473

Generating costs as a percentage of tailgate value: 56.45%

Allowable deduction (2/3 of tailgate value)..... $8,645,473

Value of geothermal production..... $6,669,505

% of total revenue..... 40.01%

Royalty amount (value of geothermal production x royalty rate)..... $666,950

% of total revenue..... 4.00%

Puna Geothermal Venture

Calculation of Royalties Based on Geothermal Netback Method

Year 3

Delivered Electricity.....	209,330,000 kwh
Tailgate Electricity..	211,423,300 kwh

Value of delivered electricity.....	$16,671,000

Transportation deduction:

Transmission line costs (cost rate x delivered electricity):

$0.006374 /kwh x 209,330,000 kwh = $1,334,188

Transmission as percentage of delivered value:	8.00%
Allowable deduction for royalty calculation (50% of electricity value).....	$1,334,188
Tailgate value of electricity.....	$15,336,812

Generating deduction

Generating costs (cost rate x tailgate electricity):

$0.040624 /kwh x 211,423,300 kwh = $8,588,872

Generating costs as a percentage of tailgate value:	56.00%
Allowable deduction (2/3 of tailgate value).....	$8,588,872
Value of geothermal production.....	$6,747,940
% of total revenue.....	40.48%
Royalty amount (value of geothermal production x royalty rate).....	$674,794
% of total revenue.....	4.05%

Puna Geothermal Venture

Calculation of Royalties Based on Geothermal Netback Method

Year 4

Delivered Electricity..... 209,330,000 kwh

Tailgate Electricity.. ..... 211,423,300 kwh

Value of delivered electricity.....$17,272,000

Transportation deduction:

Transmission line costs (cost rate x delivered electricity):

$0.006271 /kwh x 209,330,000 kwh = $1,312,662

Transmission as percentage of delivered value: 7.60%

Allowable deduction for royalty calculation
(50% of electricity value)..... $1,312,662

Tailgate value of electricity.....$15,959,338

Generating deduction

Generating costs (cost rate x tailgate electricity):

$0.040379 /kwh x 211,423,300 kwh = $8,537,081

Generating costs as a percentage of tailgate value: 53.49%

Allowable deduction (2/3 of tailgate value)..... $8,537,081

Value of geothermal production..... $7,422,258

% of total revenue..... 42.97%

Royalty amount (value of geothermal production x royalty rate)..... $742,226

% of total revenue..... 4.30%

Puna Geothermal Venture

Calculation of Royalties Based on Geothermal Netback Method

Year 5

Delivered Electricity..... 209,330,000 kwh

Tailgate Electricity.. ..... 211,423,300 kwh

Value of delivered electricity.....$17,938,000

Transportation deduction:

Transmission line costs (cost rate x delivered electricity):

$0.006169 /kwh x 209,330,000 kwh = $1,291,460

Transmission as percentage of delivered value: 7.20%

Allowable deduction for royalty calculation
(50% of electricity value)..... $1,291,460

Tailgate value of electricity.....$16,646,540

Generating deduction

Generating costs (cost rate x tailgate electricity):

$0.040158 /kwh x 211,423,300 kwh = $8,490,338

Generating costs as a percentage of tailgate value: 51.00%

Allowable deduction (2/3 of tailgate value)..... $8,490,338

Value of geothermal production..... $8,156,202

% of total revenue..... 45.47%

Royalty amount (value of geothermal production x royalty rate)..... $815,620

% of total revenue..... 4.55%

Puna Geothermal Venture

Calculation of Royalties Based on Geothermal Netback Method

Year 6

Delivered Electricity..... 209,330,000 kwh

Tailgate Electricity.. ..... 211,423,300 kwh

Value of delivered electricity.....$18,638,000

Transportation deduction:

Transmission line costs (cost rate x delivered electricity):

$0.006070 /kwh x 209,330,000 kwh = $1,270,599

Transmission as percentage of delivered value: 6.82%

Allowable deduction for royalty calculation
(50% of electricity value)..... $1,270,599

Tailgate value of electricity.....$17,367,401

Generating deduction

Generating costs (cost rate x tailgate electricity):

$0.039962 /kwh x 211,423,300 kwh = $8,448,897

Generating costs as a percentage of tailgate value: 48.65%

Allowable deduction (2/3 of tailgate value)..... $8,448,897

Value of geothermal production..... $8,918,504

% of total revenue..... 47.85%

Royalty amount (value of geothermal production x royalty rate)..... $891,850

% of total revenue..... 4.79%

Puna Geothermal Venture

Calculation of Royalties Based on Geothermal Netback Method

Year 7

Delivered Electricity.....	209,330,000 kwh	
Tailgate Electricity..	211,423,300 kwh	
Value of delivered electricity.....		$18,638,000
Transportation deduction:		
Transmission line costs (cost rate x delivered electricity):		
$0.005972 /kwh x 209,330,000 kwh =	$1,250,095	
Transmission as percentage of delivered value:		6.71%
Allowable deduction for royalty calculation (50% of electricity value).....		$1,250,095
Tailgate value of electricity.....		$17,387,905
Generating deduction		
Generating costs (cost rate x tailgate electricity):		
$0.039792 /kwh x 211,423,300 kwh =	$8,413,023	
Generating costs as a percentage of tailgate value:		48.38%
Allowable deduction (2/3 of tailgate value).....		$8,413,023
Value of geothermal production.....		$8,974,882
% of total revenue.....		48.15%
Royalty amount (value of geothermal production x royalty rate).....		$897,488
% of total revenue.....		4.82%

Puna Geothermal Venture

Calculation of Royalties Based on Geothermal Netback Method

Year 8

Delivered Electricity..... 209,330,000 kwh

Tailgate Electricity.. ..... 211,423,300 kwh

Value of delivered electricity.....$20,144,000

Transportation deduction:

Transmission line costs (cost rate x delivered electricity):

$0.005876 /kwh x 209,330,000 kwh = $1,229,967

Transmission as percentage of delivered value: 6.11%

Allowable deduction for royalty calculation
(50% of electricity value)..... $1,229,967

Tailgate value of electricity.....$18,914,033

Generating deduction

Generating costs (cost rate x tailgate electricity):

$0.039650 /kwh x 211,423,300 kwh = $8,382,993

Generating costs as a percentage of tailgate value: 44.32%

Allowable deduction (2/3 of tailgate value)..... $8,382,993

Value of geothermal production.....$10,531,040

% of total revenue..... 52.28%

Royalty amount (value of geothermal production x royalty rate)..... $1,053,104

% of total revenue..... 5.23%

Puna Geothermal Venture

Calculation of Transmission-line Cost Rate

Depreciation Method

Cost Rate = E + D + I / F

E = Operating and maintance expenses

D = Depreciation

I = Return on undepreciated investment (based on 10%)

F = Annual delivered electricity

Cost Rate =		Year
	0.006584 /kwh	1
	0.006478	2
	0.006374	3
	0.006271	4
	0.006169	5
	0.006070	6
	0.005972	7
	0.005876	8

Year	(E) O & M	(D) Depreciation	(I) Return on Undepreciated Investment	(F) Electricity Delivered
1	$120,000	$285,714	$1,000,000	213,516,600
2	$126,000	$285,714	$971,429	213,516,600
3	$132,300	$285,714	$942,857	213,516,600
4	$138,915	$285,714	$914,286	213,516,600
5	$145,861	$285,714	$885,714	213,516,600
6	$153,154	$285,714	$857,143	213,516,600
7	$160,811	$285,714	$828,571	213,516,600
8	$168,852	$285,714	$800,000	213,516,600

This amount is Generated Elect. Delivered Elect = 209,330,000

Year	Investment Balance (begin yr)	Annual Depreciation	Depreciated Investment (end of year)	Return on Investment
1	$10,000,000	$285,714	$9,714,286	$1,000,000
2	$9,714,286	$285,714	$9,428,571	$971,429
3	$9,428,571	$285,714	$9,142,857	$942,857
4	$9,142,857	$285,714	$8,857,143	$914,286
5	$8,857,143	$285,714	$8,571,429	$885,714
6	$8,571,429	$285,714	$8,285,714	$857,143
7	$8,285,714	$285,714	$8,000,000	$828,571
8	$8,000,000	$285,714	$7,714,286	$800,000

Puna Geothermal Venture

Calculation of Transmission-line Cost Rate

Return on Investment Method

Cost Rate = E + R / F

E = Operating and maintance expenses

R = Return on investment (based on 10%)

F = Annual delivered electricity

Cost Rate =		Year
	0.005245 /kwh	1
	0.005274	2
	0.005303	3
	0.005334	4
	0.005367	5
	0.005401	6
	0.005437	7
	0.005474	8

should be 209,330,000

(F) Electricity Delivered
213,516,600

Year	Investment	Rate of Return	(R) Return on Investment	(E) O & M
1	$10,000,000	10.00%	$1,000,000	$120,000
2	$10,000,000	10.00%	$1,000,000	$126,000
3	$10,000,000	10.00%	$1,000,000	$132,300
4	$10,000,000	10.00%	$1,000,000	$138,915
5	$10,000,000	10.00%	$1,000,000	$145,861
6	$10,000,000	10.00%	$1,000,000	$153,154
7	$10,000,000	10.00%	$1,000,000	$160,811
8	$10,000,000	10.00%	$1,000,000	$168,852

Puna Geothermal Venture

Calculation of Generating Cost Rate

Depreciation Method

Cost Rate = E + D + I / F

E = Operating and maintance expenses

D = Depreciation (based on 10%)

I = Return on undepreciated investment

F = Annual ~~delivered~~ Gross electricity — see page 11

Cost Rate =	Year
0.041181 /kwh	1
0.040892	2
0.040624	3
0.040379	4
0.040158	5
0.039962	6
0.039792	7
0.039650	8

should be 219,000,000 (25MW x 24 hrs x 365 days)

Year	(E) O & M	(D) Depreciation	(I) Return on Undepreciated Investment	(F) Electricity Delivered Gross
1	$1,850,000	$1,542,857	$5,400,000	213,516,600
2	$1,942,500	$1,542,857	$5,245,714	213,516,600
3	$2,039,625	$1,542,857	$5,091,429	213,516,600
4	$2,141,606	$1,542,857	$4,937,143	213,516,600
5	$2,248,687	$1,542,857	$4,782,857	213,516,600
6	$2,361,121	$1,542,857	$4,628,571	213,516,600
7	$2,479,177	$1,542,857	$4,474,286	213,516,600
8	$2,603,136	$1,542,857	$4,320,000	213,516,600

Year	Investment Balance (beginning of year)	Annual Depreciation	Depreciated Investment (end of year)	Return on Investment
1	$54,000,000	$1,542,857	$52,457,143	$5,400,000
2	$52,457,143	$1,542,857	$50,914,286	$5,245,714
3	$50,914,286	$1,542,857	$49,371,429	$5,091,429
4	$49,371,429	$1,542,857	$47,828,571	$4,937,143
5	$47,828,571	$1,542,857	$46,285,714	$4,782,857
6	$46,285,714	$1,542,857	$44,742,857	$4,628,571
7	$44,742,857	$1,542,857	$43,200,000	$4,474,286
8	$43,200,000	$1,542,857	$41,657,143	$4,320,000

Puna Geothermal Venture

Calculation of Generating Cost Rate

Return on Investment Method

Cost Rate = E + R / F

E = Operating and maintance expenses

R = Return on investment (based on 10%)

F = Annual ~~delivered~~ gross electricity — see page 13

Cost Rate =		Year
	0.036765 /kwh	1
	0.036765	2
	0.036765	3
	0.036765	4
	0.036765	5
	0.036765	6
	0.036765	7
	0.036765	8

(F) Electricity Delivered
213,516,600

Year	Investment	Rate of Return	(R) Return on Investment	(E) O & M
1	$60,000,000	10.00%	$6,000,000	$1,850,000
2	$60,000,000	10.00%	$6,000,000	$1,850,000
3	$60,000,000	10.00%	$6,000,000	$1,850,000
4	$60,000,000	10.00%	$6,000,000	$1,850,000
5	$60,000,000	10.00%	$6,000,000	$1,850,000
6	$60,000,000	10.00%	$6,000,000	$1,850,000
7	$60,000,000	10.00%	$6,000,000	$1,850,000
8	$60,000,000	10.00%	$6,000,000	$1,850,000

Puna Geothermal Venture
Calculation of Royalty Waiver Based on Expanded Netback Method
Assumptions

	Source of Assumption	Year One of Operations
Electricity delivered (kwh)	PGV	209,330,000
Electricity generated (kwh)	Estimated	213,516,600
Electricity tailgate (as measured on the high voltage side of the transformer) (kwh)	Estimated	211,423,300
Electricity revenues (energy and capacity)	PGV	$16,671,000
Resource delivered (pounds)	Estimated	5184000000
Lease royalty rate		10.00%
S & P BBB Industrial Bond Rate (150%)	Estimated	15.00%
Transmission-line costs		
Capital costs	PGV	$10,000,000
Salvage value	Estimated	$0
Length of electric sales contracts (years)	PGV	35
Operating and maintenance costs	PGV	$120,000
S & P BBB Industrial Bond Rate	Estimated	15.00%
Cost rate - Depreciation Method (per/kwh)	Exhibit 7	0.008925
Cost rate - Return on Investment Method(per/kwh)	Exhibit 7	0.007587
Method used for netback calculation 1-Depreciation 2-Investment		1
Generating costs		
Capital costs	PGV	$60,000,000
Salvage value	Estimated	$6,000,000
Length of electric sales contracts (years)	PGV	35
Operating and maintenance costs	PGV	$1,850,000
S & P BBB Industrial Bond Rate	Estimated	15.00%
Cost rate - Depreciation Method (per/kwh)	Exhibit 7	0.041181
Cost rate - Return on Investment Method(per/kwh)	Exhibit 7	0.036765
Method used for netback calculation 1-Depreciation 2-Investment		1

Puna Geothermal Venture
Calculation of Royalty Waiver Based on Expanded Netback Method
Assumptions (Cont)

Steamfield costs			
	Capital costs	PGV	$20,000,000
	Salvage value	Estimated	$2,000,000
	Length of electric sales contracts (years)	PGV	35
	Operating and maintenance costs	PGV	$221,000
	S & P BBB Industrial Bond Rate	Estimated	15.00%
	Cost rate - Depreciation Method (per/pound)	Exhibit 7	0.000663
	Cost rate - Return on Investment Method(per/lbs)	Exhibit 7	0.000621
	Method used for netback calculation 1-Depreciation 2-Investment		1

Puna Geothermal Venture

Calculation of Royalty Waiver Based on Expanded Netback Method
Year 1

Delivered Electricity..... 209,330,000 kwh
Tailgate Electricity.. ..... 211,423,300 kwh

Value of delivered electricity.....$16,671,000

Transportation deduction:

Transmission line costs (cost rate x delivered electricity):

$0.008925 /kwh x 209,330,000 kwh = $1,868,347

Transmission as percentage of delivered value: 11.21%

Allowable deduction for waiver calculation..... $1,868,347

Tailgate value of electricity.....$14,802,653

Generating deduction

Generating costs (cost rate x tailgate electricity):

$0.053827 /kwh x 211,423,300 kwh = $11,380,182

Generating costs as a percentage of tailgate value: 76.88%

Allowable deduction for waiver calculation.....$11,380,182

Value of geothermal production..... $3,422,471

Steamfield deduction

Steamfield cost (cost rate x delivered resource):

$0.000663 /lb x 5184000000 lbs = $3,435,286

Steamfield costs as a percentage of geothermal production value: 100.37%

Allowable deduction for waiver calculation..... $3,435,286

Value available for royalty payments..... ($12,815)

Royalty amount as calculated by the netback method..... $658,620

Amount due..... $0

Puna Geothermal Venture

Calculation of Royalty Waiver Based on Expanded Netback Method
Year 2

Delivered Electricity	209,330,000 kwh
Tailgate Electricity	211,423,300 kwh

Value of delivered electricity $16,671,000

Transportation deduction:

Transmission line costs (cost rate x delivered electricity):

$0.008753 /kwh x 209,330,000 kwh = $1,832,213

Transmission as percentage of delivered value: 10.99%

Allowable deduction for waiver calculation $1,832,213

Tailgate value of electricity $14,838,787

Generating deduction

Generating costs (cost rate x tailgate electricity):

$0.053176 /kwh x 211,423,300 kwh = $11,242,616

Generating costs as a percentage of tailgate value: 75.77%

Allowable deduction for waiver calculation $11,242,616

Value of geothermal production $3,596,172

Steamfield deduction

Steamfield cost (cost rate x delivered resource):

$0.000650 /lb x 5184000000 lbs = $3,369,193

Steamfield costs as a percentage of geothermal production value: 93.69%

Allowable deduction for waiver calculation $3,369,193

Value available for royalty payments $226,979

Royalty amount as calculated by the netback method $666,950

Amount due $226,979

Puna Geothermal Venture

Calculation of Royalty Waiver Based on Expanded Netback Method
Year 3

Delivered Electricity..... 209,330,000 kwh
Tailgate Electricity.. ..... 211,423,300 kwh

Value of delivered electricity.....$16,671,000

Transportation deduction:
Transmission line costs (cost rate x delivered electricity):

$0.008582 /kwh x 209,330,000 kwh = $1,796,373

Transmission as percentage of delivered value: 10.78%

Allowable deduction for waiver calculation..... $1,796,373

Tailgate value of electricity.....$14,874,627

Generating deduction
Generating costs (cost rate x tailgate electricity):

$0.052547 /kwh x 211,423,300 kwh = $11,109,629

Generating costs as a percentage of tailgate value: 74.69%

Allowable deduction for waiver calculation.....$11,109,629

Value of geothermal production..... $3,764,999

Steamfield deduction
Steamfield cost (cost rate x delivered resource):

$0.000637 /lb x 5184000000 lbs = $3,303,653

Steamfield costs as a percentage of geothermal
production value: 87.75%

Allowable deduction for waiver calculation..... $3,303,653

Value available for royalty payments..... $461,346

Royalty amount as calculated by the netback method..... $674,794

Amount due..... $461,346

Puna Geothermal Venture

Calculation of Royalty Waiver Based on Expanded Netback Method
Year 4

Delivered Electricity..... 209,330,000 kwh
Tailgate Electricity.. ..... 211,423,300 kwh

Value of delivered electricity.....$16,671,000

Transportation deduction:
Transmission line costs (cost rate x delivered electricity):

$0.008412 /kwh x 209,330,000 kwh = $1,760,841

Transmission as percentage of delivered value: 10.56%

Allowable deduction for waiver calculation..... $1,760,841

Tailgate value of electricity.....$14,910,159

Generating deduction
Generating costs (cost rate x tailgate electricity):

$0.051941 /kwh x 211,423,300 kwh = $10,981,450

Generating costs as a percentage of tailgate value: 73.65%

Allowable deduction for waiver calculation.....$10,981,450

Value of geothermal production..... $3,928,709

Steamfield deduction
Steamfield cost (cost rate x delivered resource):

$0.000625 /lb x 5184000000 lbs = $3,238,692

Steamfield costs as a percentage of geothermal production value: 82.44%

Allowable deduction for waiver calculation..... $3,238,692

Value available for royalty payments..... $690,016

Royalty amount as calculated by the netback method..... $742,226

Amount due..... $690,016

Puna Geothermal Venture

Calculation of Royalty Waiver Based on Expanded Netback Method
Year 5

Delivered Electricity..... 209,330,000 kwh
Tailgate Electricity.. ..... 211,423,300 kwh

Value of delivered electricity.....$16,671,000

Transportation deduction:

Transmission line costs (cost rate x delivered electricity):

$0.008244 /kwh x 209,330,000 kwh = $1,725,634

Transmission as percentage of delivered value: 10.35%

Allowable deduction for waiver calculation..... $1,725,634

Tailgate value of electricity.....$14,945,366

Generating deduction

Generating costs (cost rate x tailgate electricity):

$0.051358 /kwh x 211,423,300 kwh = $10,858,321

Generating costs as a percentage of tailgate value: 72.65%

Allowable deduction for waiver calculation.....$10,858,321

Value of geothermal production..... $4,087,045

Steamfield deduction

Steamfield cost (cost rate x delivered resource):

$0.000612 /lb x 5184000000 lbs = $3,174,341

Steamfield costs as a percentage of geothermal production value: 77.67%

Allowable deduction for waiver calculation..... $3,174,341

Value available for royalty payments..... $912,704

Royalty amount as calculated by the netback method..... $815,620

Amount due..... $815,620

Puna Geothermal Venture

Calculation of Royalty Waiver Based on Expanded Netback Method
Year 6

Delivered Electricity..... 209,330,000 kwh
Tailgate Electricity.. ..... 211,423,300 kwh

Value of delivered electricity.....$16,671,000

Transportation deduction:

Transmission line costs (cost rate x delivered electricity):

$0.008077 /kwh x 209,330,000 kwh = $1,690,767

Transmission as percentage of delivered value: 10.14%

Allowable deduction for waiver calculation..... $1,690,767

Tailgate value of electricity.....$14,980,233

Generating deduction

Generating costs (cost rate x tailgate electricity):

$0.050801 /kwh x 211,423,300 kwh = $10,740,494

Generating costs as a percentage of tailgate value: 71.70%

Allowable deduction for waiver calculation.....$10,740,494

Value of geothermal production..... $4,239,739

Steamfield deduction

Steamfield cost (cost rate x delivered resource):

$0.000600 /lb x 5184000000 lbs = $3,110,630

Steamfield costs as a percentage of geothermal production value: 73.37%

Allowable deduction for waiver calculation..... $3,110,630

Value available for royalty payments..... $1,129,110

Royalty amount as calculated by the netback method..... $891,850

Amount due..... $891,850

Puna Geothermal Venture

Calculation of Royalty Waiver Based on Expanded Netback Method
Year 7

Delivered Electricity..... 209,330,000 kwh
Tailgate Electricity.. ..... 211,423,300 kwh

Value of delivered electricity.....$16,671,000

Transportation deduction:

Transmission line costs (cost rate x delivered electricity):

$0.007912 /kwh x 209,330,000 kwh = $1,656,258

Transmission as percentage of delivered value: 9.93%

Allowable deduction for waiver calculation..... $1,656,258

Tailgate value of electricity.....$15,014,742

Generating deduction

Generating costs (cost rate x tailgate electricity):

$0.050270 /kwh x 211,423,300 kwh = $10,628,233

Generating costs as a percentage of tailgate value: 70.79%

Allowable deduction for waiver calculation.....$10,628,233

Value of geothermal production..... $4,386,510

Steamfield deduction

Steamfield cost (cost rate x delivered resource):

$0.000588 /lb x 5184000000 lbs = $3,047,590

Steamfield costs as a percentage of geothermal production value: 69.48%

Allowable deduction for waiver calculation..... $3,047,590

Value available for royalty payments..... $1,338,920

Royalty amount as calculated by the netback method..... $897,488

Amount due..... $897,488

Puna Geothermal Venture

Calculation of Royalty Waiver Based on Expanded Netback Method
Year 8

Delivered Electricity.....	209,330,000 kwh	
Tailgate Electricity..	211,423,300 kwh	
Value of delivered electricity.....		$16,671,000
Transportation deduction:		
Transmission line costs (cost rate x delivered electricity):		
$0.007749 /kwh x 209,330,000 kwh =	$1,622,124	
Transmission as percentage of delivered value:	9.73%	
Allowable deduction for waiver calculation.....		$1,622,124
Tailgate value of electricity.....		$15,048,876
Generating deduction		
Generating costs (cost rate x tailgate electricity):		
$0.049767 /kwh x 211,423,300 kwh =	$10,521,817	
Generating costs as a percentage of tailgate value:	69.92%	
Allowable deduction for waiver calculation.....		$10,521,817
Value of geothermal production.....		$4,527,060
Steamfield deduction		
Steamfield cost (cost rate x delivered resource):		
$0.000576 /lb x 5184000000 lbs =	$2,985,255	
Steamfield costs as a percentage of geothermal production value:	65.94%	
Allowable deduction for waiver calculation.....		$2,985,255
Value available for royalty payments.....		$1,541,805
Royalty amount as calculated by the netback method.....		$1,053,104
Amount due.....		$1,053,104

Puna Geothermal Venture

Calculation of Transmission-line Cost Rate

Depreciation Method

Cost Rate = E + D + I / F

E = Operating and maintance expenses

D = Depreciation

I = Return on undepreciated investment

F = Annual delivered electricity

		Year
Cost Rate =	0.008925 /kwh	1
	0.008753	2
	0.008582	3
	0.008412	4
	0.008244	5
	0.008077	6
	0.007912	7
	0.007749	8

Year	(E) O & M	(D) Depreciation	(I) Return on Undepreciated Investment	(F) Electricity Delivered
1	$120,000	$285,714	$1,500,000	213,516,600
2	$126,000	$285,714	$1,457,143	213,516,600
3	$132,300	$285,714	$1,414,286	213,516,600
4	$138,915	$285,714	$1,371,429	213,516,600
5	$145,861	$285,714	$1,328,571	213,516,600
6	$153,154	$285,714	$1,285,714	213,516,600
7	$160,811	$285,714	$1,242,857	213,516,600
8	$168,852	$285,714	$1,200,000	213,516,600

Year	Investment Balance (begin yr)	Annual Depreciation	Depreciated Investment (end of year)	Return on Investment
1	$10,000,000	$285,714	$9,714,286	$1,500,000
2	$9,714,286	$285,714	$9,428,571	$1,457,143
3	$9,428,571	$285,714	$9,142,857	$1,414,286
4	$9,142,857	$285,714	$8,857,143	$1,371,429
5	$8,857,143	$285,714	$8,571,429	$1,328,571
6	$8,571,429	$285,714	$8,285,714	$1,285,714
7	$8,285,714	$285,714	$8,000,000	$1,242,857
8	$8,000,000	$285,714	$7,714,286	$1,200,000

Puna Geothermal Venture

Calculation of Transmission-line Cost Rate

Return on Investment Method

Cost Rate = E + R / F

E = Operating and maintance expenses

R = Return on investment

F = Annual delivered electricity

		Year
Cost Rate =	0.007587 /kwh	1
	0.007615	2
	0.007645	3
	0.007676	4
	0.007708	5
	0.007743	6
	0.007778	7
	0.007816	8

(F) Electricity Delivered
213,516,600

Year	Investment	Rate of Return	(R) Return on Investment	(E) O & M
1	$10,000,000	15.00%	$1,500,000	$120,000
2	$10,000,000	15.00%	$1,500,000	$126,000
3	$10,000,000	15.00%	$1,500,000	$132,300
4	$10,000,000	15.00%	$1,500,000	$138,915
5	$10,000,000	15.00%	$1,500,000	$145,861
6	$10,000,000	15.00%	$1,500,000	$153,154
7	$10,000,000	15.00%	$1,500,000	$160,811
8	$10,000,000	15.00%	$1,500,000	$168,852

Puna Geothermal Venture

Calculation of Generating Cost Rate

Depreciation Method

Cost Rate = E + D + I / F

E = Operating and maintance expenses

D = Depreciation

I = Return on undepreciated investment

F = Annual delivered electricity

		Year
Cost Rate =	0.053827 /kwh	1
	0.053176	2
	0.052547	3
	0.051941	4
	0.051358	5
	0.050801	6
	0.050270	7
	0.049767	8

Year	(E) O & M	(D) Depreciation	(I) Return on Undepreciated Investment	(F) Electricity Delivered
1	$1,850,000	$1,542,857	$8,100,000	213,516,600
2	$1,942,500	$1,542,857	$7,868,571	213,516,600
3	$2,039,625	$1,542,857	$7,637,143	213,516,600
4	$2,141,606	$1,542,857	$7,405,714	213,516,600
5	$2,248,687	$1,542,857	$7,174,286	213,516,600
6	$2,361,121	$1,542,857	$6,942,857	213,516,600
7	$2,479,177	$1,542,857	$6,711,429	213,516,600
8	$2,603,136	$1,542,857	$6,480,000	213,516,600

Year	Investment Balance (beginning of year)	Annual Depreciation	Depreciated Investment (end of year)	Return on Investment
1	$54,000,000	$1,542,857	$52,457,143	$8,100,000
2	$52,457,143	$1,542,857	$50,914,286	$7,868,571
3	$50,914,286	$1,542,857	$49,371,429	$7,637,143
4	$49,371,429	$1,542,857	$47,828,571	$7,405,714
5	$47,828,571	$1,542,857	$46,285,714	$7,174,286
6	$46,285,714	$1,542,857	$44,742,857	$6,942,857
7	$44,742,857	$1,542,857	$43,200,000	$6,711,429
8	$43,200,000	$1,542,857	$41,657,143	$6,480,000

Puna Geothermal Venture

Calculation of Generating Cost Rate

Return on Investment Method

Cost Rate = E + R / F

E = Operating and maintance expenses

R = Return on investment

F = Annual delivered electricity

		Year
Cost Rate =	0.050816 /kwh	1
	0.050816	2
	0.050816	3
	0.050816	4
	0.050816	5
	0.050816	6
	0.050816	7
	0.050816	8

(F) Electricity Delivered
213,516,600

Year	Investment	Rate of Return	(R) Return on Investment	(E) O & M
1	$60,000,000	15.00%	$9,000,000	$1,850,000
2	$60,000,000	15.00%	$9,000,000	$1,850,000
3	$60,000,000	15.00%	$9,000,000	$1,850,000
4	$60,000,000	15.00%	$9,000,000	$1,850,000
5	$60,000,000	15.00%	$9,000,000	$1,850,000
6	$60,000,000	15.00%	$9,000,000	$1,850,000
7	$60,000,000	15.00%	$9,000,000	$1,850,000
8	$60,000,000	15.00%	$9,000,000	$1,850,000

Puna Geothermal Venture

Calculation of Steamfield Cost Rate

Depreciation Method

Cost Rate = E + D + I / F

E = Operating and maintance expenses

D = Depreciation

I = Return on undepreciated investment

F = Annual delivered resource (pounds of steam)

Year	Cost Rate =
1	0.000663 /pound of steam
2	0.000650
3	0.000637
4	0.000625
5	0.000612
6	0.000600
7	0.000588
8	0.000576

Per Morris –

5,184,000,000 lbs ÷ 24 hrs ÷ 345 days = 591,781 lbs/hr for 25 MW

591,781 ÷ 25 = 23,671 lbs/MW

Per PGV –

480,000 lbs/hr for 25 MW plant

480,000 ÷ 25 = 19,200 lbs/MW

Year	(E) O & M	(D) Depreciation	(I) Return on Undepreciated Investment	(F) Resource Delivered
1	$221,000	$514,286	$2,700,000	5184000000
2	$232,050	$514,286	$2,622,857	5184000000
3	$243,653	$514,286	$2,545,714	5184000000
4	$255,835	$514,286	$2,468,571	5184000000
5	$268,627	$514,286	$2,391,429	5184000000
6	$282,058	$514,286	$2,314,286	5184000000
7	$296,161	$514,286	$2,237,143	5184000000
8	$310,969	$514,286	$2,160,000	5184000000

Year	Investment Balance (beginning of year)	Annual Depreciation	Depreciated Investment (end of year)	Return on Investment
1	$18,000,000	$514,286	$17,485,714	$2,700,000
2	$17,485,714	$514,286	$16,971,429	$2,622,857
3	$16,971,429	$514,286	$16,457,143	$2,545,714
4	$16,457,143	$514,286	$15,942,857	$2,468,571
5	$15,942,857	$514,286	$15,428,571	$2,391,429
6	$15,428,571	$514,286	$14,914,286	$2,314,286
7	$14,914,286	$514,286	$14,400,000	$2,237,143
8	$14,400,000	$514,286	$13,885,714	$2,160,000

Puna Geothermal Venture

Calculation of Steamfield Cost Rate

Return on Investment Method

Cost Rate = E + R / F

E = Operating and maintance expenses

R = Return on investment

F = Annual delivered resource (pounds of steam)

Cost Rate =		Year
	0.000621 /pound of steam	1
	0.000623	2
	0.000626	3
	0.000628	4
	0.000631	5
	0.000633	6
	0.000636	7
	0.000639	8

Year	Investment	Rate of Return	(R) Return on Investment	(E) O & M	(F) Resource Delivered
1	$20,000,000	15.00%	$3,000,000	$221,000	5184000000
2	$20,000,000	15.00%	$3,000,000	$232,050	5184000000
3	$20,000,000	15.00%	$3,000,000	$243,653	5184000000
4	$20,000,000	15.00%	$3,000,000	$255,835	5184000000
5	$20,000,000	15.00%	$3,000,000	$268,627	5184000000
6	$20,000,000	15.00%	$3,000,000	$282,058	5184000000
7	$20,000,000	15.00%	$3,000,000	$296,161	5184000000
8	$20,000,000	15.00%	$3,000,000	$310,969	5184000000